JPRS 74032

17 August 1979

USSR Report

ENGINEERING AND EQUIPMENT

No. 57

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ORIGINALLY ISSUED ON 17 AUGUST 1979

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50272-101

REPORT DOCUMENTATION PAGE	1. REPORT NO. JPRS 74032	2.	3. Recipient's Accession No.

4. Title and Subtitle

USSR REPORT: ENGINEERING AND EQUIPMENT, No. 57

5. Report Date
17 August 1979

6.

7. Author(s)

8. Performing Organization Rept. No.

9. Performing Organization Name and Address

Joint Publications Research Service
1000 North Glebe Road
Arlington, Virginia 22201

10. Project/Task/Work Unit No.

11. Contract(C) or Grant(G) No.

(C)

(G)

12. Sponsoring Organization Name and Address

As above

13. Type of Report & Period Covered

14.

15. Supplementary Notes

16. Abstract (Limit: 200 words)

The report contains articles, abstracts and news items on aeronautical, marine, mechanical, automotive, civil and industrial engineering, related research and development, and engineering materials and equipment.

17. Document Analysis   a. Descriptors

USSR
Aeronautics
Industrial Engineering
Marine Engineering
Stress Analysis
Turbines
Metrology

b. Identifiers/Open-Ended Terms

c. COSATI Field/Group   1A, 13H, 13J, 14B

19. Security Class (This Report) UNCLASSIFIED	21. No. of Pages 45
20. Security Class (This Page) UNCLASSIFIED	22. Price

(See ANSI-Z39.18)

OPTIONAL FORM 272 (4-77)
(Formerly NTIS-35)
Department of Commerce

USSR REPORT

ENGINEERING AND EQUIPMENT

No. 57

This serial publication contains articles, abstracts of articles and news items from USSR scientific and technical journals on the specific subjects reflected in the table of contents.

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MATHEMATICAL DESCRIPTION OF PERFORMANCE CHARACTERISTICS OF DISTRICT HEATING
TURBINE UNITS IN COMPUTER CALCULATIONS

VINOGRADNIK, M. V., engineer, and KURNOSOV, A. T., candidate of technical
sciences, Ukrainian State Institute for Design and Planning of Metallurgi-
cal Plants, Voronezh Construction Engineering Institute

[Abstract] The authors consider the problem of mathematical representation
of curves for steam consumption as a function of power load for district
heating turbine units. This mathematical description is required in compu-
ter solution of such problems as optimum load distribution among torbogen-
erators, optimum heating of water in the network, calculating norms for spe-
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cal description is based on the following requirements: results must be re-
liable in calculations beyond the limits of the performance characteristics;
universal applicability; description of the functional dependence shown by
the performance characteristics with a small number of equations; logical
simplicity of conditions for selecting equations based on information con-
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working conditions of the turbine facility; simple methods for curve analysis
and calculation of coefficients for the equations. The paper gives a compari-
son of the proposed technique with the method of experiment planning. Figures
3; references 6 (Russian).

COMPUTERIZED OPTIMUM DISTRIBUTION OF LOADS AMONG THE TURBOGENERATORS OF
FOSSIL-FUEL ELECTRIC POWER PLANTS

FOSHKO, L. S., candidate of technical sciences, ZUSMANOVICH, L. B., FLOS,
S. L., PAL'CHIK, V. A. and KONEVSKIY, B. I., engineers, Dontekhenergo

[Abstract] The authors consider the problem of determining the optimum dis-
tribution of loads among turbogenerators in a fossil-fuel power plant, based
on satisfying the following requirements: distribution of electrical and
thermal loads to minimize the heat expended on the turbine unit; calculation
based on turbogenerator characteristics that most completely describe oper-
ating conditions; no constraints on the configuration of turbogenerator per-
formance characteristics; calculation of load distribution based on net char-
acteristics including the internal needs of the turbogenerators; considera-
tion of all operational limitations in turbogenerator working conditons; re-
sults should be applicable to any predetermined differential of the load
change. A flowchart is given showing the organization of the Optim-76 pro-
gram complex for solution of this problem. An example is given showing ap-
plication of the Optim-76 program implemented by a Minsk-32 computer in the
case of a heat and electric power station with three turbogenerators. The
results show that a dynamic programming method has considerable advantages
for this application on third-generation computers. Figure 1; references 9
(Russian).

TEMPERATURE STATE OF A 200 MW TURBINE AT REDUCED ROTOR SPEED

KOBZARENKO, L. N., engineer, MADOYAN, A. A., candidate of technical sciences,
PASHCHENKO, V. V., GRECHANYY, A. N., ZALIZSKIY, A. G. and SEMESHKO, N. S.,
engineers, Southern Affiliate of the All-Union Scientific Research Institute
of Heat Engineering imeni F. E. Dzerzhinski

[Abstract] The authors consider the problem of putting steam turbine power
units on standby during the period of minimum loading of a power plant. One
way to do this is by reducing the fuel supply to the boiler unit to a level
where the turbine runner turns at a speed just below the first critical
speed. To determine the feasibility of using this method, studies were done
on an experimental 200 MW facility. Data are given on the temperature state
of the main elements of the power facility when standby operation under

nighttime electrical loading conditions is handled by the proposed method, by start-stop operation and also in the motor regime. It is shown that the method of reducing runner speed to 900-1000 rpm for standby operation reduces the reliability and maneuverability of the turbine as compared with the other two methods. Figure 1; references 2 (Russian).

SHMIDT, K. L., Moscow Higher School imeni N. E. Bauman

[Abstract] One way of solving the problem of increasing power shortages is the use of gas turbines discharging their exhaust gases into low-pressure boilers of steam power stations. The Moscow Higher School imeni N. E. Bauman has in this connection analyzed the performance of various gas turbines (GT-950, GT-100, GT-100-750, GT-200-1050, GT-125-1050) discharging their exhaust gases into the boiler of the K-500-130-2 steam turbine. Analysis showed that the use of the GT-100-750 gas turbine in a boiler-turbine unit including one K-500 steam turbine and three GT-100-750 gas turbines improves the unit's operating economy by reducing fuel consumption by 1% compared with the K-500+GT-950 unit and by 4.8% compared with the K-500+GT-100-750 unit, owing to greater recovery of the heat of the exhaust gases of the GT-100-750 gas turbines, and the use of that heat for the partial heating of the steam power station feedwater.

USSR   UDC 621.165.001.5

EFFECT THAT RADIAL CLEARANCE IN THE GUIDE VANE ASSEMBLY HAS ON THE REACTION AND EFFICIENCY OF AN AXIAL-FLOW TURBINE

[Abstract] The radial clearance between nozzle blading and the housing is designed to avert temperature-induced deformations and assure blade adjustment in the presence of unsteady turbine operating modes. Most often that clearance equals 0.5-1% of blade height. In this connection formulas for the effect of radial clearance on the degree of turbine reaction and on turbine efficiency are derived with allowance for the blade outlet angle. Calculations based on these formulas and confirmed by experiments conducted at the Kazan' Aviation Institute showed that when the relative radial clearance equals 1% of blade height, the degree of turbine reaction increases by 0.01-0.015, and turbine efficiency decreases, by 2-2.5% if the radial clearance is located at blade periphery, and by 3-3.5% if the clearance is located at blade root. Figures 3; references 2 (Russian).

PROBLEMS OF CREATION OF LASER INSTALLATIONS FOR PRODUCTION OF A HIGH-TEMPERATURE PLASMA

MAK, A. A., doctor of sciences

[Abstract] A brief history and survey of the status of the problem of creation of high energy lasers for production of thermonuclear plasmas are presented. Particular attention is given to the most significant results achieved by the Soviets in recent years, including the production of time-profiled pulses, self-focusing of radiation in an amplifier channel and methods of controlling it, and dynamic adjustment of the radiation wave front. The results which have been achieved lead to the hope that the method of averaging is promising for suppression of the effects related to self-focusing of powerful, extremely short radiation pulses. Figures 4; references 45 (Russian).

PLASMA SOURCES WITH HIGH RADIATION INTENSITY

PODMOSHENSKIY, I. V., candidate of technical sciences

[Abstract] During the past decade, the State Institute of Optics has actively pursued a program of creation and investigation of forms of discharge specifically suited for the construction of light sources to meet the demands of modern optics. This article discusses plasma brightness standards, sources for intensive radiation, including a high current discharge pressed against a wall by crossed magnetic fields, a lamp with gas protection of quartz, and a multilayer pulsed discharge. In all, three plasma brightness standards have been created, encompassing the wave lengths from 75 to 6,000 nm, similar to a black body at 30,000-40,000 K. The new plasma sources have expanded the capabilities for controlling physical experiments in the area of dense, low-temperature plasmas. Table .; references 37: 36 Russian, 1 Western.

DIRECT-ACTION ACCELERATORS WITH INDUCTIVE ENERGY ACCUMULATOR AND EXPLODING WIRES

BAKULIN, YU. D., DIYANKOV, V. S., KOVALEV, V. P., KORMILITSYN, A. I.,
LAVRENT'YEV, B. N., LUCHINSKIY, A. V. and MARTYNOV, V. I.

[Abstract] Usually the high-voltage pulse generator used in direct-action
accelerators for producing short bursts of electrons and bremsstrahlung is
based on a long line charged by an Arkad'yev-Marx circuit. This paper de-
scribes pulse generators in which the main element is an inductive accumu-
lator with commutation by exploding wires. Such generators are the basis of
the IGUR-I and IGUR-II facilities that produce pulsed bremsstrahlung and
electron beams. With a voltage of 2.8 MV across the accelerator tube and a
current of 44 kA through the tube, the IGUR-I produces a bremsstrahlung dose
of 110 r at a distance of 1 m from the anode. The corresponding dose is 700
r for the IGUR-II for a voltage of 3.7 MV and current of 70 kA. The half-
width of the bremsstrahlung pulse on either facility can be regulated in a
range of 0.1-0.5 µs. Electron beams with energy density of 300 J/cm^2 are
coupled out of the accelerator tubes. Figures 2; references 6: 3 Russian,
3 Western.

A METHOD OF CONTROLLING FERRITE MAGNETIZATION IN EXPERIMENTS ON SELF-ACCELERATION OF AN ELECTRON BEAM

RAKITYANSKIY, A. A.

[Abstract] The author considers the self-acceleration of an electron beam
as it passes through electromagnetic structures filled with an unsaturated
or gyrotropic ferrite. As the pulse passes, the particles expend energy in
magnetizing the ferrite. With a rapid reduction of the beam current, the
magnetic field energy stored in the ferrite is converted to the energy of
an electric eddy field in which some particles on the trailing edge of the
pulse are accelerated. In the gyrotropic ferrite, energy conversion is by
impact excitation of free precession of the magnetic moment, while in the
unsaturated ferrite magnetic reversal takes place in the azimuthal direction.
A technique is described for compensation and wide-range control of the azi-
muthal field in the ferrite, and beam experiments are done on using this

technique to select the operating point on the ferrite magnetization curve
so as to maximize the effect of self-acceleration. Magnetizing is done by
two coaxial solenoids that are simultaneously used for beam focusing. The
paper gives the results of an experimental study of the described method.
The author thanks A. M. Shenderovich for discussing the results and con-
structive criticism. Figures 3; references 4 (Russian).

A FUNCTIONAL GENERATOR OF CONTROLLING VOLTAGE FOR A LINAC ENERGY MODULATOR

BEZNOGIKH, YU. D., VOYEVODIN, M. A. and SAYFULIN, N. A., Joint Institute
of Nuclear Research, Dubna

[Abstract] The paper describes a functional generator for producing the
controlling voltage of the energy modulator of a synchrophasotron injector.
A sync pulse is sent to input shapers, one of which consists of an inverter
and a Schmidt trigger, while the other is made up of an inverter and a kipp
oscillator. The pulse from the Schmidt limiter triggers a delay kipp oscil-
lator with pulse duration controllable from 10 µs to 1 ms. As the trailing
edge of this pulse passes through another shaper, it triggers a control kipp
oscillator with output pulse duration controllable in a range of 500-600 µs,
equal to the duration of the injection pulse. The pulse from the control
kipp oscillator enables triggering of a count pulse oscillator that produces
a pulse train with recurrence rate adjustable from 600 to 700 kHz. This
pulse train goes to frequency dividers that divide it by 4 and by 10. Simul-
taneously, an enabling pulse is sent to the second frequency divider (sub-
multiple of 10) and to the input of a multiplexer, where it controls an inte-
grator. Nine pulses from the second frequency divider go to a counter and
to the multiplexer for monitoring. The output pulses from the counter go to
a preliminary decoder. The counter is reset by a pulse from a special shaper.
The multiplexer circuit shapes the necessary function. Seven signals from
the decoder go to control switches in the multiplexer for final decoding. A
signal also goes from the second input shaper to an analog adder circuit in
the multiplexer. The pulses from the control switches go one after the other
to the gates of FETs that act as analog switches and send the voltage from
regulating potentiometers to the input of the integrator. The output voltage
from the integrator goes to a buffer amplifier and through a final stage to
the output. The proposed generator can produce a pulse of negative polarity
with any law of rise in the working part. The duration of the working part

of the pulse is 300-700 μs. There are nine levels of discretization and the output voltage is 10 V. The delay control range relative to the sync pulse is 10-1000 μs. The generator is triggered by a sync pulse of positive polarity with amplitude of 3-10 V and duration of 5-10 μs. The authors thank V. A. Popov for constructive criticism, and also P. N. Buylov, A. A. Anashin and V. L. Smirnov for making and aligning the various parts of the generator. Figure 1; references 10 (Russian).

MEASURING THE INTEGRAL CHARACTERISTICS OF INTENSE PULSED ELECTRON BEAMS

GLEBOV, V. V., MALAFAYEV, V. A. and NOViCHKOV, D. N., All-Union Electrical
Engineering Institute, Moscow

[Abstract] A technique is developed for simultaneous measurements of the
distribution of current densities and the spectrum of energies that charac-
terize quasi-steady distribution of a pulsed electron beam. The experiments
were done with an electron beam of about 100 A current, energy of about
300 keV and duration of about 100 μs. The beam was sent through a drift tube
50 cm in diameter and 5 m long with a beam-deflecting system. The deflect-
ing magnetic system was continuously controllable from 0 to 10 Gs, enabling
displacement of the beam 5 m from the anode by an amplitude of 20 cm. The
measurement system included a collector made up of graphite plates fastened
to a Teflon board, and also a magnetic analyzer. Electrons pass through a
collimator and are incident on graphite plates in the analyzer. Each of the
plates in the collector and the analyzer is connected to a capacitor, and
analysis is done by a step switch that connects the capacitors in sequence
to an oscilloscope. Measurement results are given. Figures 3; references
4 (Russian).

A METHOD OF EVALUATING THE DENSITY DISTRIBUTION OF A DEUTERON BEAM

BESSARABSKIY, YU. G., OVSYANNIKOV, S. B., PROKOP'YEV, V. M. and SUKHOVEYEV,
S. P.

[Abstract] A technique is described for experimentally finding the relative
distribution of deuteron current density on a target in acceleration tubes
that use the reaction $T(d,n)^4He$ by measuring the induced positron activity
in copper indicators from the reaction $^{63}Cu(n,2n)^{62}Cu$ on the outside of the
tritium target, and comparing the resultant distribution with the theoreti-
cal distribution calculated fro a preselected function of relative distribu-
tion of deuteron current density on the target. The described method can be
used for nondestructive testing of the characteristics of ion-optical systems
in sealed accelerator tubes as they are put into operation. Figures 3; ref-
erences 2 (Russian).

A FAST-NEUTRON SPECTROMETER BASED ON AN ELECTROSTATIC CHARGE-EXCHANGE ACCELERATOR

TRUFANOV, A. M., NESTERENKO, V. S., FETISOV, N. I., LOVCHIKOVA, G. N.,
DEMENKOV, V. G., SAL'NIKOV, O. A., ROMANOV, V. A., GLOTOV, A. I., SPIRIN,
V. I., KOTEL'NIKOVA, G. V. and BASHMAKOV, V. S.

[Abstract] The paper describes a time-of-flight spectrometer based on the
EGP-10M electrostatic charge-exchange accelerator for measuring both dis-
crete and continuous spectra resulting from various nuclear reactions such
as (n,n), (n,n'), $(n,2n)$, (p,n), $(n,n'\gamma)$, (n,f) and the like. The EGP-10M
accelerator enables continuous variation of the energy of accelerated hydro-
gen and deuterium ions over a range of 1.5-10 MeV. Ion pulse duration at
the target is about 1 ns with a pulse recurrence rate of 5 MHz. Maximum
average beam current is about 2.5 μA. Differential nonlinearity was found
to be 0.5%, and integral nonlinearity--no worse than 0.2%. Figures 3; ref-
erences 15: 11 Russian, 4 Western.

THE KRISTALL GONIOMETRIC FACILITY WITH ELECTRONIC CONTROL SYSTEM

AGARKOV, N. A., GORBENKO, V. G., ZHEBROVSKIY, YU. V., ZELENCHER, A. S.,
KOLESNIKOV, L. YA., RUBASHKIN, A. L. and CHECHETENKO, V. F.

[Abstract] The paper describes the Kristall goniometric facility with elec-
tronic control system developed for use with the linac at Khar'kov Physico-
technical Institute, Academy of Sciences UkrSSR. The unit is made in the
form of two identical goniometer heads in a common vacuum chamber housing.
In this way, single crystals of different thicknesses can be used under the
same experimental conditions, or coherent bremsstrahlung can be studied from
targets with different atomic numbers. The single crystal is oriented in
the field of the electron beam by rotation about mutually perpendicular axes
in the vertical and horizontal planes, and also about an axis perpendicular
to the horizontal axis. Positioning is done by eight motors that are remote-
ly controlled by an electronic system with eight self-contained channels. In
laboratory tests, positioning accuracy was found to be within 1.8". The de-
vice can be used to get a beam of quasi-monochromatic linearly polarized
photons. In future the facility is to be used on-line with the M6000 compu-
ter. The authors thank P. V. Sorokin for interest in the work and useful
discussions, and also V. A. Balyasov, L. S. Slyutenko and V. N. Berezke for
making and aligning the goniometric device. Figures 3; references 7: 3 Rus-
sian, 4 Western.

COMBINED OPERATION OF A STREAMER CHAMBER AND CONVERSI HODOSCOPE TUBES

GOVOROV, V. V., DAVIDENKO, V. A., DOLGOSHEIN, B. A., LEBEDEV, A. N. and
SOMOV, S. V.

[Abstract] The authors consider the feasibility of making a neutrino spec-
trometer based on a gas-discharge (Conversi) hodoscope by combining a hodo-
scope of large mass with a streamer chamber. Such a detector could be made
by modifying an existing 8-meter streamer chamber at the Institute of High-
Energy Physics. The amplitudes, rise times and durations of the high-volt-
age pulses used for power supply in hodoscopic chambers differ considerably
from the corresponding pulse parameters for streamer chambers, and since

these parameters determine discharge brightness, gas composition and pressure, time resolution, registration efficiency, charge accumulation on the walls of the tube, grades of glass for the tubes and requirements for preparation for work, the feasibility of combining these systems depends on the electrical compatibility of the streamer chamber and hodoscope system with consideration of these characteristics. The paper gives the results of studies of the properties of gas-discharge tubes placed in the sensitive region of a streamer chamber. It is shown that combined operation of a streamer chamber and a Conversi hodoscope tubes is possible. Working conditions are proposed in which particles are registered simultaneously in the streamer chamber and the hodoscope tube. Since the short pulse used to supply the streamer chamber reduces the long-lasting effect, ordinary glass can replace low-resistivity glass. Figures 3; references 5 (Western).

USING THE AUTOMATIC HPD FACILITY FOR PROCESSING PHOTOGRAPHS FROM THE MIRABEL' CHAMBER IN A K^+p EXPERIMENT AT 32 GeV

BOROVIKOV, A. A., BRYZGALOV, V. V., GUMENYUK, S. A., RYBIN, A. M. and KHROMOVA, G. N., Institute of High-Energy Physics, Serpukhov

[Abstract] The paper gives the results of adaptation of the HPD automatic digitizer to analysis of photographs from the Mirabel' bubble chamber at the Serpukhov High-Energy Physics Institute in a K^+p experiment at 32 GeV/c. Two automatic HPD units operating in the pulse mode form the basis of measurement instrumentation in experiments on the Mirabel' chamber. The scanning zone is set by predigitizing photographs on the PUOS-2 and MPS projectors under supervision of a tracking program in the Faust system that provides man-machine interaction with the ICL-1930A computer. Ninety-nine percent of all track segments are filtered out by the Fil'tr program on the ICL-1906A computer. The kinematic parameters of the tracks--momentum, dip angle and azimuth angle--are determined by the HYDRA-GEOMETRY program on the ICL-1906A computer. Kinematic analysis of events is done by the GRIND program on the same computer. It is shown that HPD processing gives expected errors close to the calculated values for beam tracks, with a noticeably wider distribution of residual deviations in the case of tracks of secondary particles. The half-width of the distribution of the square of the deficient mass MM^2 is less than the square of the mass of π° mesons. The width of the mass distribution of identified K° mesons (3C fit) is comparable to the value typical of classical bubble chambers such as the CERN 2-meter chamber. Figures 2; references 7: 6 Russian, 1 Western.

A CIRCUIT FOR HIGH-VOLTAGE SUPPLY TO MULTIPLE-GAP SPARK CHAMBERS

ANAN'IN, P. S., GLAVANAKOV, I. V., KASHIRIN, A. P. and STIBUNOV, V. N.,
Scientific Research Institute of Nuclear Physics at Tomsk Polytechnical
Institute

[Abstract] An investigation is made of a parallel high-voltage circuit for
power supply to multiple-gap spark chambers from a single generator. The
ground electrodes of the chamber are connected to the generator housing
through pulse transformer windings in opposition for electrical decoupling
of adjacent spark gaps and equalizing discharge currents. The inductive
reactance of the transformer windings is selected to be greater than the in-
ternal resistance of the generator. Oscillograms of voltage pulses with
transformer decoupling show that after discharge develops in one gap, the
voltage is retained on the adjacent gap for a time that exceeds the time
spread of spark formation in the chamber. The proposed power supply circuit
gives high effectiveness of particle registration at lower field intensities
than required without transformer decoupling. The brightness of sparks is
uniform, and stopping of particles in the chamber is reliably recorded. Fig-
ures 3; references 7: 5 Russian, 2 Western.

EFFICIENCY OF REGISTRATION OF GAMMA QUANTA BY NaI(Tl) CRYSTALS FOR CYLINDRI-
CAL VOLUMETRIC SOURCES

BAMBLEVSKIY, V. P., Joint Institute of Nuclear Research, Dubna

[Abstract] A formula is derived for computer calculation of the efficiency
of registration of gamma quanta. Calculations are done for a thallium-acti-
vated sodium iodide detector crystal in the geometry shown in the figure.
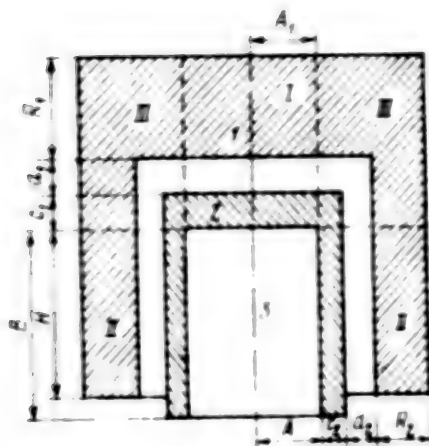
1--source; 2--packing; 3--crystal

The source can be subdivided into regions I, II and III. Calculations were done by the proposed formulas for each section with an error of no more than 2%. It is experimentally shown that the proposed technique can be used for sources in Marinelli geometry in an isotropic field of gamma quanta, and also for sources in the form of disks and cylinders of arbitrary dimensions, tubes and rings with inside radii no less than the radius of the crystal. The author thanks M. M. Komochkov for continued interest in the work, and also A. I. Saltykov for consultation in developing the algorithm for calculation. Figures 8; references 11: 4 Russian, 7 Western.

GUSEV, A. A., NAZAROVA, N. I., PUGACHEVA, G. I. and TITENKOV, A. F., Scientific Research Institute of Nuclear Physics, Moscow State University

[Abstract] The authors describe a detector designed for registration of transient x-radiation in the energy range of 3-50 keV. The facility is a double proportional counter. The upper compartment has a beryllium window 250 μm thick, and the thickness of the working volume of the counter is 15 mm. Each compartment is made up of sections with transverse dimensions of 15 x 15 mm. Tungsten filaments 20 μm in diameter, electrically connected

together, are used as the anode in each section. Special springs keep the force of tension on the filaments constant at 30 g in the presence of temperature fluctuations and operating loads. The counter is filled with a mixture of 95% Xe and 5% CH_4 to a pressure of 0.95 atm. The working voltage of the counter is in a range of 1400-1550 V, and breakdown voltage is 1950-2000 V. X-ray quanta pass through the beryllium window in the upper compartment, and relativistic particle ionization is measured in the lower chamber. Counter dimensions are selected so as to ensure effective registration of the pulse induced by an x-ray quantum of transient radiation against the background of the pulse due to ionization of a relativistic particle. The time and spectrometric characteristics of the counter are given. A series of three of the instruments was installed on the Interkosmos-17 artificial earth satellite to record the transient radiation induced by superhigh-energy electrons. Figures 3; references 7: 2 Russian, 5 Western.

AN EFFECTIVE NEUTRON DETECTOR WITH ^{3}He FOR TIME-OF-FLIGHT SPECTROMETRY

BOGOMOLOV, V. N., ZAKHARKIN, I. I., KUZNETSOV, V. A. and SHCHETININ, O. I.

[Abstract] Improvements are described in the KN-5 neutron detector with ^{3}He radiator. An additional electrode in the form of a grid formed by parallel metal filaments is inserted between the central and outer electrodes to act as a collector, while the outer and inner electrodes form the cathode, which is grounded. The gird has a radius of 21 mm, and the distance between filaments is 4.4 mm. The housing is 1 mm thick and 80 mm in outside diameter. The housing and flanges are made of Kh18N9T stainless steel, and the ^{3}He pressure is 11,500 mm Hg. The interelectrode capacitance of the detector is about 35 pF. The average signal delay time at a supply voltage of 2.7 kV is about 4.4 µs. The gas amplification is about 9. The detector has satisfactory amplitude characteristics and efficiency of about 0.9 for neutrons with energy of 1 eV. Figures 3; references 5: 4 Russian, 1 Western.

A POSITION-SENSITIVE PROPORTIONAL NEUTRON COUNTER

GAL'TSOV, V. S., ZAKHARKIN, I. I., KUZNETSOV, V. A. and SHCHETININ, O. I.

[Abstract] The paper describes a proportional neutron counter in which
ionization events are localized with respect to the time displacement of
signals propagating toward both ends of the counter. The rate of signal
propagation is reduced by a considerable increase in the distributed induc-
tance and capacitance of the counter which is achieved by using a helical
cathode that forms an electromagnetic delay line together with the grounded
outer housing. By appropriate selection of the delay line parameters, time
intervals between signals can be obtained that are reliably measurable with
modern electronic instruments. When a charged particle appears in the work-
ing chamber, the gas is ionized, after which the electrons that are formed
move toward the anode under the action of the electric field. Gas amplifi-
cation occurs close to the anode, and as a result when the positive avalanche
ions move toward the cathode a negative current pulse is induced on the anode,
and a positive pulse is induced on the cathode. If the particle track is
short, the density distribution of the charge induced on the cathode in the
direction of the counter axis is spatially localized. From the cathode re-
gion adjacent to the site of primary ionization, signals of identical magni-
tude propagate toward both ends of the helix at a rate that is determined
by the parameters of the delay line. The time shift of the signals arriving
at both ends of the cathode uniquely determines the position of the primary
ionization event. Figures 3; references 2 (Russian).

A CATHODE UNIT FOR GAS DISCHARGE DEVICES

LAZAREV, N. F. and ARSHBA, D. B.

[Abstract] Hollow cold cathodes have a long service life and can operate
continuously in aggressive media, but material sputtered from the inside
surface settles on the components and electrodes of the gas discharge device.
The authors describe a cathode unit with a filtering element for cleaning
the plasma (see the diagram).
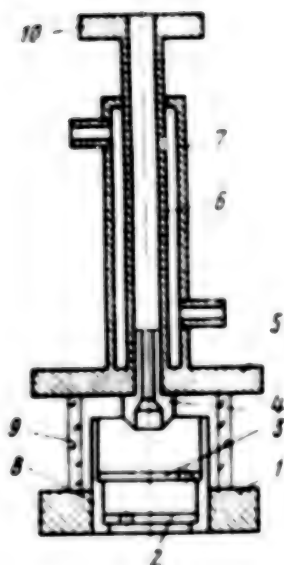
1--Flange of the housing of the filtering element; 2,3--diaphragms; 4--working element of the hollow cathode; 5--flange of the hollow cathode; 6--hollow cathode; 7--cooling jacket; 8--housing of the filtering element; 9--insulator; 10--flange for connection to vacuum pump

Interchangeable working element 4 made of a material with low sputterability (stainless steel) is fastened to hollow cathode 6 with 10 mm inside diameter of the copper tube and length of 500 mm. The small channel of the working element is 6 mm in diameter and 25 mm long, and the large channel is 10 mm in diameter and 10 mm long. Diaphragms 2 and 3 are 0.5 mm thick with openings of 5 mm diameter. The diaphragms are 12 mm apart and installed so that the opening of one is completely covered by the body of the other. Electrical insulation between flanges 1 and 5 is provided by porcelain insulator 9 with height of 50 mm, inside diameter of 50 mm and outside diameter of 60 mm. The insulator will withstand a voltage of 1-1.2 kV. Housing 8 of the filtering element is 2-3 mm smaller in outside diameter than the inside diameter of the insulator. Sputtered particles entrained in the plasma pass through the opening in the diaphragm closest to the cathode. The neutral particles moving in the direction of the axis of this opening settle out on the second diaphragm, while the charged particles change direction and pass through the opening in the second diaphragm. For greater purification, more diaphragms can be used. The filtering action was checked by measuring the current of ions of cathode material at the output of a mass spectrograph.

Without the filtering element, this current was $(1-6) \cdot 10^{-11}$ A, and with the filtering element the current dropped to less than 10^{-13} A (the limit of the UI-2 electrometric DC amplifier). The authors thank R. A. Demirkhanov and V. V. Dorokhov for interest in the work. Figures 2; references 4: 2 Russian, 2 Western.

USING MIXTURES OF HYDROGEN WITH CERTAIN GASES TO INCREASE THE YIELD OF PROTONS IN A HIGH-FREQUENCY ION SOURCE

MARKUS, A. M., UDOVENKO, V. F. and VELICHKO, N. I., Physicotechnical Institute of Low Temperatures, Academy of Sciences UkrSSR, Khar'kov

[Abstract] An examination is made of working conditions of an rf source based on mixtures of hydrogen with certain gases to get a higher percent concentration of protons in a discharge region excited by an rf field. Experiments were done on mixtures of hydrogen with He, N_2, Ne, Ar, Kr and Xe. It is shown that the relative increase in the yield of atomic ions of hydrogen depends on the ionization potential of the dopant gas. The maximum effect was observed with helium. Figures 3; references 4: 3 Russian, 1 Western.

FOCUSING OF PHOTOELECTRONS IN THE FEU-49 PHOTOMULTIPLIER

DADYKIN, V. L., YELENSKIY, YA. S. and TSYABUK, A. L., Institute of Nuclear Research, Academy of Sciences USSR, Moscow

[Abstract] The paper gives the characteristics of the FEU-49 photomulti-plier with application of a magnetic field of 0-120 A/m for different com-binations of potentials of the focusing electrodes. It was found that a transverse magnetic field of 16 A/m has little influence on the character-istics of the input chamber of the tube, and the same can be said of a field of 80 A/m parallel to the axis of the tube. Focusing is optimum when the electrode potentials are set for spectrometric working conditions. When the voltage across the working chamber is increased to 500 V, focusing is dis-rupted only in a transverse magnetic field in excess of 40 A/m. In this case, the earth's magnetic field has practically no influence on the proper-ties of the FEU-49 photomultiplier. The authors thank A. Ye. Chudakov for continued interest in the work and constructive criticism. Figures 5; ref-erences 3 (Russian).

COMPARING THE TIME RESOLUTION OF PHOTOMULTIPLIERS AND DYNODE CHANNEL MULTI-PLIERS

IVANOV, A. I., KOTIK, A. G., FROLOV, YE. A. and KHARITONOV, I. A., All-Union Scientific Research Institute of Metrology, Leningrad

[Abstract] A comparison is made between the time resolution of an FEU-36 photomultiplier with a stilbene crystal and a VEU-6 dynode channel multipli-er. The start-stop technique was used with a cobalt-60 source. In the case of the FEU-36, two time-correlated gamma quanta were registered with energy of 1.17 and 1.33 MeV. Time resolution was 0.6 ns. In the case of the VEU-6 dynode channel multiplier, the cobalt-60 source produced time-correlated Compton electrons that were registered with a resolution of 2.6 ns. The

poorer time resolution of the channel multiplier is attributed to the con-
ditions of primary electron capture and the time spread as the electrons
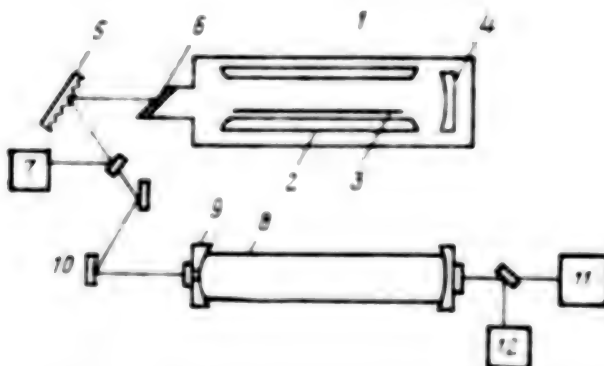are multiplied in the dynode. Figures 2; references 6 (Russian).

AN OPTICALLY PUMPED SUBMILLIMETER PULSE LASER FOR PLASMA DIAGNOSIS

MANITA, O. F., Khar'kov State University

[Abstract] The paper is a report on the results of studies of the optically
pumped submillimeter pulse laser shown in the diagram.

1--anode; 2--cathode; 3--additional electrode; 4--mirror with radius of
curvature of 10 m; 5--echelette grating; 6--Brewster window; 7--CO_2 laser
radiation receiver; 8--cell of the submillimeter laser; 9--submillimeter
laser mirrors; 10--focusing mirror; 11--submillimeter emission receiver;
12--calorimeter

The CO_2 laser has emission energy of 0.8 J in a pulse lasting 150 ns. The
cathode is comb-shaped with 3 mm glass tubes in the slots carrying the addi-
tional electrodes (wires 0.8 mm in diameter). The diffraction grating can
be rotated to tune the laser output. Pulse recurrence rate is 1-5 Hz. The
submillimeter laser cavity is a , be 80 mm in diameter. Mirrors 9 are cop-
per with radius of curvature of 1 m. Radiation is coupled in through an
opening 1.5 mm in diameter, and coupled out through an opening 12 mm in di-
ameter. The spacing between mirrors is 80 cm. The output wavelength was

from 66 to 1256 m depending on the molecule of the active gas: NH_3, CH_3OH, CH_3F, CH_3I, D_2O, HCOOH, CH_3Br, N_2H_4. The output energy has a clearly pronounced maximum. Pulse duration is from 3 to 0.5 μs, decreasing with increasing pressure. Pumping energy is converted to output energy with an efficiency of about 0.1%. Measurement of the divergence of the submillimeter output showed that 70% of all the energy is contained in a solid angle of $5 \cdot 10^{-3}$ rad. Emission linewidth is about 300 MHz. Figures 3; references 9: 2 Russian, 7 Western.
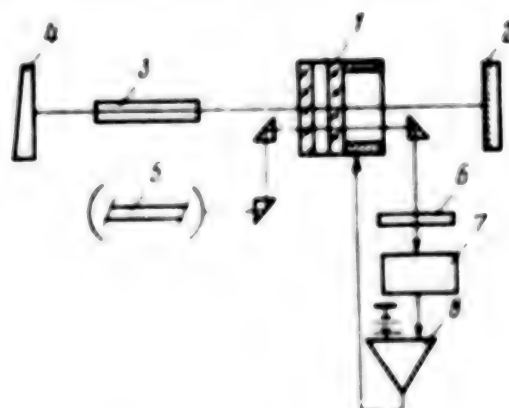
A FREQUENCY-STABILIZED RUBY LASER

BONDARENKO, A. N. and KRUGLOV, S. V.

[Abstract] The article describes a frequency-stabilized laser that operates in the mode of free emission. The figures shows a schematic of the device.

Frequency selection and stabilization is done by high-Q scanning Fabry-Perot interferometer 1 located in the cavity between opaque mirror 2 and ruby crystal 3. The distance between the mirrors (base) of the interferometer is 3 mm and the coefficient of reflection of the mirrors is 0.98. The output mirror 4 is a wedge-shaped glass plate with coefficient of reflection of 0.04. The cavity is 50 cm long. The interferometer base is rigidly stabilized by an optoelectronic negative feedback system that includes stabilized Ne-Ne

laser 5, interference light filter 6, photodiode 7 and differential ampli-
fier 8. The interferometer is adjusted so that its resonant frequency co-
incides with the center of the amplification line of ruby. A change in
photocurrent from the control system with respect to the reference current
applied to the other input of the differential amplifier produces an output
signal that is sent to a piezoceramic control element in the base of the
interferometer. The proposed system compensates for both slow (temperature)
and rapid (acoustic) deviations. Operation for 1.5 hours with 45 laser
bursts every 2 minutes showed rms deviation of emission frequency from the
average of no more than 0.003 cm^{-1}. Energy and emission threshold are also
stabilized. Figures 2; references 2 (Russian).

A WIDE-BAND UNIT FOR PHASE-FREQUENCY TIE-IN OF LASERS

GOL'DORT, V. G., ZAKHAR'YASH, V. F. and KURNEVICH, B. A., Institute of
Thermal Physics, Siberian Department, Academy of Sciences USSR, Novosibirsk

[Abstract] A system is proposed for frequency-locking lasers with the ca-
pability of changing the difference frequency. The facility is a combina-
tion of static (frequency) and astatic (phase) control rings. The purpose
of the frequency ring is to bring the difference frequency of the lasers
into the lock-in band of the phase system. The beats of the lasers are sent
from a photodetector simultaneously to linear phase and frequency detectors.
The combined amplified signal of both detectors is used to adjust the opti-
cal length of the laser. This unit can be used for frequency tie-in of
lasers in the presence of vibrational and acoustic disturbances of laser
frequency exceeding the holding and locking band for the phase control ring,
and for automatic phase-locking of lasers when these perturbations drop to
acceptable levels. The range of difference frequencies is 0.5-15 MHz with
sensitivity of about 100 µV and regulation band of up to 20 kHz. The unit
has been used to get a super-narrow He-Ne laser emission line, for enabling
the Zeeman effect in CH_4 and for recording beats of two stabilized lasers.
Figures 3; references 4 (Russian).

USSR   UDC 536.6

A MULTICHANNEL HIGH-SPEED X-RAY SPECTROMETER

BONDARENKO, V. A., MAGDA, I. I., NAYSTETER, S. I., PUSHKAREV, S. S. and
SKACHEK, G. V.

[Abstract] The paper describes a multichannel spectrometer for x-ray emis-
sion of a plasma formed by a high-current relativistic electron beam. An-
alysis of such x-ray spectra gives information on the nature of plasma-beam
interaction and the dynamics of the distribution function of a nonequili-
brium and unsteady plasma. The spectrometer consists of four identical
channels, each containing a collimator, an absorbing foil, a scintillator,
a flexible light guide and an EL"-FT photomultiplier with time resolution
of better than 1.5 ns. The signals are read out on a 6-beam 6-LOR-02 os-
cillograph. The instrument uses plastic scintillators (polystyrene doped
with POPOP) with de-excitation time of 2.2 ± 0.2 ns. The quantum distribu-
tion of x-radiation can be measured over a range of 0.2-50 keV by a tech-
nique described in the article when thin copper, aluminum and beryllium
foils are used and the scintillators have a thickness of 0.1-2 mm.

USSR   UDC 621.373.5

AN X-RAY PULSE GENERATOR

YAROVOY, P. N., Scientific Research Institute of Applied Physics at Irkutsk
State University

[Abstract] The standard URS-55A x-ray unit is used to stimulate atoms in
studying the kiretics of such processes as damping of phosphor luminescence.
However, the URS-55A unit operates in the quasi-cw mode with half-wave recti-
fication and high duty factor, so that it cannot be used to study compara-
tively long relaxation processes. To reduce the pulse generation frequency,
the primary of the high-voltage transformer in the x-ray unit is connected
to the line through a thyristor controlled by a master oscillator based on
a dynistor, resistors and capacitors. A switch is provided for discrete
and continuous control of pulse recurrence rate in ranges of 0.6-1.3 and
0.1-1 Hz by regulating the supply voltage of the master oscillator within
limits of 15-30 V. The output pulses are bell-shaped with duration of 1
ms on the base. Figure 1; references 1 (Russian).

A MYLAR ATTENUATOR FOR CO_2 LASER EMISSION

LEVIN, G. I.

[Abstract] A method is described for CO_2 laser beam attenuation by using multiple-layer Mylar filters. This material absorbs radiation very weakly in the 10.6 μm range and is not damaged by a beam with power density of up to $5 \cdot 10^4$ W/cm^2 when pulse duration is up to 100 μs, but has a high coefficient of reflection (up to about 0.15 per surface). This enables fairly smooth control of energy attenuation over a wide range by using filters with different numbers of Mylar layers. An experimental facility is described for determining the degree of attenuation of laser emission by Mylar filters. Such filters considerably extend the range of measurements of pulse power and energy as well as pulse shape. Figures 2.

USSR   UDC   621.186.3.531.787.91:536.532.001.24

DETERMINING THE PARAMETERS OF UNSTEADY STEAM FLOW IN TURBINE DISCHARGE LINES

TOKAR', I. YA., doctor of technical sciences, LESHCHINSKIY, G. A. and MAN-
ZHAY, V. P., engineers, Ukrainian Polytechnical Correspondence Institute

[Abstract] Vibrations of the discharge lines have been observed when the
discharge valves are opened in the intermediate steam superheating section
on 300 MW turbine units. These vibrations are due to considerable dynamic
forces developed by unsteady movement of steam in the lines. Determination
of these forces requires knowledge of the gasdynamic flow parameters that
depend on time and longitudinal coordinate in the line. The distribution of
velocities, pressures, temperatures and densities of the flow were found by
numerical solution of a system including equations of conservation of mass,
momentum and energy of the superheated steam, the equation of state, and also
equations of heat transfer to the wall of the tubing and its insulation.
These equations were reduced to characteristic form and solved by a matrix
sweep-out method. The input data were provided by pressure measurements with
series-produced strain gages and temperature measurements with chromel-alumel
thermocouples. The proposed approach enables estimation of the gasdynamic
forces and points the way to effective techniques for eliminating vibrations
of tubing in large power plants. Figures 6; references 3 (Russian).

USSR   UDC 627.8.001.573

HIGH-HEAD HYDRAULIC LABORATORY AT THE KRASNOYARSK HYDROELECTRIC PLANT

BUKHANOV, V. V., RUBINSHTEYN, G. L., engineers, YELISEYEV, N. A. and LYAPIN,
V. YE., candidates of technical sciences

[Abstract] Because of the difficulties involved in accurate solution of
many practical problems in hydraulics by modeling methods, experimental
facilities are needed for studies under conditions close to full-scale. For
this reason, work is now in progress on a high-head hydraulic laboratory at
the Krasnoyarsk Hydroelectric Plant. Water comes to the experimental facili-
ty by gravity flow from the reservoir. This will provide a flowrate of 30
m^3/s at a head of 0.8 MPa. There are to be three experimental sections:
1. a combination of a head section, an inclined chute and a horizontal
channel; 2. a head section, an inclined pipe, a horizontal pipe, a head-
pressure storage tank, a model reservoir, a glass-lined chute and a gage

spillway; 3. a similar installation with a vacuum tank. The second and third sections are serviced by an overhead crane with lifting capacity of 20 metric tons. Figure 1.

SHOCK WAVE IN FRONT OF A BLUNT SOLID OF REVOLUTION IN A GRADIENT FLOW

KARDANOV, YU. KH., Moscow Higher Technical School imeni Bauman

[Abstract] Analysis of shadow photographs of the flow of a jet of gas around blunt obstacles shows that the extent and shape of the shock wave in front of a blunt solid of revolution are functions of the magnitude and direction of the velocity vector. Corresponding engineering formulas are presented, with allowance for deviation of the velocity vector from the axial direction, and for the nonuniform distribution of flow parameters. It is shown that the distribution of gas-dynamic parameters within the core of a jet bounded at one end by the nozzle outlet and at the other by the compression wave is then nonuniform both in the axial and in the transverse directions. The effect that gradients of gas-dynamic parameters in the jet core have on the extent and shape of the shock wave in the front of the blunted body is computed. Comparison with experimental data demonstrates satisfactory accuracy of the new computational method. The new method makes it possible to compute more accurately the shape and extent of the shock wave arising in front of blunt solids of revolution located at considerable distances from the axis of symmetry of the jet, as well as in the presence of small distances between the nozzle and the obstacle. Figures 3; references 6 (Russian).

STABILITY OF A ROD IN AN AXIAL FLOW OF VISCOUS FLUID

GRIGOR'YEV, YU. V., GUS'KOV, A. M. and SVETLINSKIY, V. A., Moscow Higher
Technical School

[Abstract] Small-scale transverse oscillations and stability of compressed
elastic rods in an axial flow of viscous fluid are investigated. This ap-
plies to many real designs such as the shank of a drilling tool, a column
of drilling pipes in a well, fuel elements in the heat exchangers of nuclear
reactors, etc. A straight rod with a circular cross section, placed in a
coaxially aligned absolutely rigid cylindrical channel is considered, the
annular gap between the rod and channel being filled with an incompressible
viscous fluid flowing in a strictly axial direction. Formulas for the sta-
bility limits of parameters of the system, namely, of flow rate and the axial
compressive force are derived, as is the equation of small flexural oscilla-
tions of the compressed rod on interaction with the axial flow of a viscous
fluid bounded by the walls of an absolutely rigid channel. If the rod is
under the load of a compressive force not exceeding the critical Euler num-
ber, it will retain stability until flow velocity reaches a specified bound-
ary value and then the rod begins to undergo transverse harmonic vibration.
When flow velocity increases still further, the rod loses its stability.
Figures 4; references 6: 4 Russian, 2 Western.

CAVITATION FLOW AROUND A THIN PERMEABLE BODY

YEFREMOV, I. I., Kiev, Institute of Hydromechanics, UkrSSR Academy of Sci-
ences

[Abstract] Earlier M. T. Bekulov (DOKL. AN SSSR, 162, No 3, 1965, pp 523-
526; "Sb. Nauchn. Rabot Aspirantov Kabardino-Balkarsk. Un-ta, 1965, No 1,
pp 445-452) examined the problem of flow around weakly permeable obstacles
from the standpoint of nonlinear geometric parameters of the perturbation
(e.g. the angle of slope of the obstacle with respect to incident flow).
Now the linear problem of cavitation flow around a thin obstacle with a
finite permeability factor is considered on the premise of uniform permea-
bility of the material of the obstacle and proportionality of the permeation

rate to the pressure drop along the permeable surface. It is further assumed that the permeable surface represents a surface of discontinuity with respect to tangential velocities. The boundary-value problem for the velocity potential of the perturbations generated by the obstacle and cavitation voids in a plane-parallel flow of an incompressible weightless fluid at the velocity v_∞ is formulated and then solved by the method of hydrodynamic singularities. It is shown that the effect of permeability results in a marked reduction in the size of cavitation bubbles without affecting the cavitation number, and that permeability has much less influence on the lift of a cavitating hydrofoil than on the characteristics of a non-cavitating hydrofoil. Figures 2; references 6: 5 Russian, 1 Western.

CHARACTERISTICS OF A LAVAL NOZZLES WITH GASDYNAMIC CONTROL

VARGANOV, I. S., Kiev Higher Military Aviation Engineering School

[Abstract] This is a continuation of an earlier study (I. S. VARGANOV, PRIKL. MEKHANIKA, 10, No 3, 1974, pp 121-124) of Laval nozzles, which had dealt with the effect of certain factors on relative required flow intake, and with the effect that the shape of the transition in the critical cross-sectional area F_{cr} has on thrust characteristics, as regards nozzles in which F_{cr} is adjustable by a gasdynamic method. Now models of Laval nozzles with and without admission of low-pressure gas to the stall zone are considered, in the presence of Reynolds numbers $Re = (0.6-0.8) \cdot 10^6$ over the critical cross section of basic flow. It is established that in models without admission of low-pressure gas to the stall zone there is a decrease in pressure and an increase in expansion (overexpansion) and, as a result, a decrease in overall engine thrust. In models with admission of low-pressure gas to the stall zone overall engine thrust increases, because then the degree of overexpansion is reduced. Figures 5; references 2 (Russian).

INVESTIGATION OF THE STRESSED STATE OF TWO-LAYER CYLINDRICAL SHELLS

PANKRATOVA, N. D., Institute of Mechanics, UkrSSR Academy of Sciences, Kiev

[Abstract] The deformation of two-layer cylindrical shells consisting of a
material that is inhomogeneous over the thickness of the layers is investi-
gated on the basis of equations of the theory of elasticity. The solution
of this class of problems is achieved through an approach based on the sepa-
ration of variables in the initial equations and the solution of boundary-
value problems for the derived systems of ordinary differential equations by
a stable numerical method. The use of numerical methods serves to surmount
the numerous difficulties associated with the inhomogeneity of the material
of the layers in the radial direction. The initial equations adopted for
each layer are the equations of the three-dimensional problem of elasticity
theory for an anisotropic body in a cylindrical coordinate system. When the
inhomogeneity of the shell's layers is substantial, the stressed state in the
hard layer is virtually independent of the thickness of the underlying layer
and, as calculations show, the soft underlying layer can be disregarded and
the investigation of the stress-strain state of the loadbearing layer can be
with sufficient accuracy based on the classical theory of thin shells. Hence,
in the three-dimensional approach to the analysis of stresses and displace-
ments, two-layer cylindrical shells may, unlike sandwich shells, be computed
in accordance with the classical theory of thin shells over a broader range
of variation in parameters, and a two-layer shell with a soft filler can be
treated like a single-layer shell on an elastic base. Figures 2; references
6 (Russian).

INVESTIGATION OF THE EFFECT OF THE POLARITY OF RIBBING ECCENTRICITY ON THE
DESIGN OF A CYLINDRICAL SHELL THAT IS OPTIMUM FROM THE STANDPOINT OF NATURAL
OSCILLATION FREQUENCY

ZARUTSKIY, V. A. and POCHTMAN, YU. M., Kiev, Institute of Mechanics, UkrSSR
Academy of Sciences, and Dnepropetrovsk Civil Engineering Institute

[Abstract] The effect of the polarity of the eccentricity of shell ribbing
and of the alignment of ribbing on the parameters of a shell of minimum
weight in the presence of a minimum natural oscillation frequency is investi-
gated on the basis of a formula and a numerical experiment performed on a
BESM-4 computer for three different specified minimum natural oscillation
frequencies, f_s = 350, 400, and 450 Hz. The polarity refers to the surface
on which the ribbing is present: "+" for outer surface of the plating and
"-" for the inner surface. Analysis of computational findings shows that
the sign of the eccentricity of longitudinal ribbing has relatively little
influence on the minimum shell weight F_{min}, and its effect decreases still
further with increase in f_s. On the other hand, the sign of the eccentricity
of annular ribbing affects F_{min} more markedly and increases with increase in
f_s. For f_s = 400 and 450 Hz the shell design reinforced with outer circular
ribbing proved to be optimal, while for f_s = 350 Hz shells reinforced with
ribs installed on inner surface had the optimal F_{min}. Comparison of the
findings with those of other investigators confirms that at sufficiently high
f_s the optimal shell is that reinforced with weak longitudinal ribbing and
strong annular ribbing, while at relatively low f_s the optimal shell is that
reinforced with strong longitudinal ribbing and weak annular ribbing. Ref-
erences 5 (Russian).

USSR   UDC [621.315.1:621.316.925].004.58

AUTOMATIC TROUBLESHOOTING OF THE RF CHANNEL OF DIFFERENTIAL-PHASE OVERHEAD
LINE PROTECTORS

POYMANOV, N. T. and PETROV, V. I., Kuzbassenergo Regional Power Administra-
tion, Kemerovsk State Regional Electric Power Plant

[Abstract] An examination is made of an automatic monitoring system for
checking the rf channel of differential-phase protectors by using a signal
element in the phase comparison unit of the protector with continuous low-
power operation of transmitters at the ends of the overhead line section
being protected. In normal operation the current in this signal element is
zero. With failure of the line channel or absence of a signal from one of
the transmitters, a keyed current of reception from one of the transmitters
remaining in operation begins to flow in the signal element of the phase
comparison unit. The element operates, signaling trouble in the rf channel.
Operation of such an automatic troubleshooting system with the DFZ-201 dif-
ferential-phase line protector is considered. Figure 1; references 3 (Rus-
sian).

USSR   UDC △539.1.074:537.312.62

A POSITION-SENSITIVE SUPERCONDUCTIVE RADIATION DETECTOR

VASILEVICH, A. F., KLYACHIN, N. A., LYAPIDEVSKIY, V. K. and PEREZHOGIN, V. B.

[Abstract] In a superconducting detector of charged particles, a current
close to critical flows through a thin film of tin or indium, and the pas-
sage of a charged particle through the detector causes local heating of the
film with disruption of superconductivity, thus producing the signal. The
authors propose utilizing the effect of thermal propagation of the normal
phase from the point of disruption to determine the coordinate of this point.
It is shown that NbTi filament of 8 and 20 μm diameter can be used to make
position-sensitive radiation detectors with resolution of 5-10 μm. The loca-
tion of the point of disruption of superconductivity is shown by the output
pulse shape on an oscilloscope. The authors thank B. M. Zhiryakov and A. K.
Fanibo for assistance in organizing the experiment, and M. S. Kozodayev for
discussing the results of the work. Figures 2; references 3 (Western).

A FACILITY FOR MEASUREMENTS OF THE LIFETIMES OF NUCLEAR LEVELS ON-LINE WITH
A COMPUTER

VAVRYSHCHUK, YA., KRUMSHTEYN, Z. V., KHEMNITS, G., KHOVANSKIY, N. N., Joint
Institute of Nuclear Research, Dubna, ALIKOV, B. A., MUMINOV, K. M., MUMINOV,
T. M., USMANOV, R. R., and KHAMRAYEV, F. KH., Samarkand State University

[Abstract] An examination is made of the feasibility of using a method of
time-shift compensation in multidimensional measurements on-line with a com-
puter for recording gamma rays in the 50-1000 keV range, and also a method
of determining the lifetimes of nuclear levels based on measuring the shifts
in the centers of gravity of the curves of delayed and prompt coincidences.
The proposed experimental facility enables analysis of the time distributions
of coincidences of many successive radiations in a single experiment. When
the method of compensating amplitude spreads of detector pulses is used, the
time resolution of the facility in an actual experiment approaches the limit-
ing values now attainable. The method of comparing the time distributions
of delayed and prompt coincidences measured in a single experiment enables
determination of lifetimes considerably shorter than the time resolution of
the facility with greater reliability and accuracy. The installation is being
successfully used by the Laboratory of Nuclear Problems at the Joint Insti-
tute of Nuclear Research to study the decay of short-lived isotopes. Figures
5; references 9: 7 Russian, 2 Western.

AN ANALOG-DIGITAL CONVERTER WITH CYCLIC REFINEMENT OF THE RESULT

AZAROV, A. D., BORODYANSKIY, M. YE. and ONOPKO, V. L., Taganrog Radio Engi-
neering Institute

[Abstract] An analog-digital converter is described with cyclic refinement
of the result. The proposed circuit considerably relaxes the error require-
ments of a multiple-threshold comparator, and simplifies the digital part of
the device that produces the final result of conversion. The device contains
a set of scaling amplifiers, an analog signal commutator, a multiple-threshold
comparator with 2^n-1 levels of comparison, a null detector, a decoder, a con-
trol unit, an adder and a set of digital-analog converters with n digital

places as well as a memory register. The facility is made with series 133 and 140 ICs, and can convert direct current voltage at 0-2.5 V to 9-place binary code. The four-cycle conversion process takes 2 µs. Figure 1; references 3 (Russian).

DIGITAL DISPLAY UNIT FOR A CAMAC CRATE

ZAMYATIN, M. I. and SMOLIN, D. A., Joint Institute of Nuclear Research, Dubna

[Abstract] The paper describes a seven-segment LED display based on a converter that changes binary information contained in CAMAC units to BCD output information. Code conversion takes place in tetrads of combination logic with capability for conversion of 16 binary digits. The panel has 20 AL304A seven-segment LED cells arranged in four bit lines of five digits each. The information contained in each of these lines corresponds to a given NAF. The four different combinations of N, A and F are stored in an accumulator based on 1YaM411 memory elements, and can be changed from the front panel of the display unit. The authors thank N. N. Shcherbakov for developing the printed circuit and making an experimental model. Figures 4; references 2 (Russian).

A FACILITY FOR STUDYING THE LUMINESCENCE OF MICROSCOPIC SPECIMENS

VOTYAKOV, S. L., VOLKOV, S. N., KRASNOBAYEV, A. A., KROKHALEV, V. YA. and SAMATOV, M. V., Institute of Geology and Geochemistry, Ural Science Center, Academy of Sciences USSR, Sverdlovsk

[Abstract] A facility is described for registration of luminescence stimulated by light, x-rays and heat in specimens with measurements of 0.7-0.8 mm. The specimen is held in a collet in a special chamber through which liquid nitrogen vapor is pumped. A mirror and lamp system is used for illuminating the specimen, and positional adjustment is provided for locating the collet

in the focus of the microscope objective. The specimen can be visually ob-
served through an ocular, and interchangeable photomultipliers are used for
photoelectric registration, the output signal being amplified and fed to a
chart recorder. Results are given of use of the device for studying the
luminescence properties of natural and synthetic zircon crystals about 1 mm
in size. The signal-to-noise ratio in this experiment was 15 or better.
Figures 2; references 4 (Russian).

A LASER MICROREFRACTOMETER FOR MEASURING TEMPERATURE GRADIENTS IN LIQUID

BAZHINOV, V. A., YEVTIKHIYEVA, O. A., RINKEVICHYUS, B. S. and SHAROV, S. K.,
Moscow Power Engineering Institute

[Abstract] Optical techniques based on gas lasers are extensively used to
measure temperature gradients in transparent media. This paper describes an
improved laser microrefractometer that can be used to study steady and un-
steady temperature fields. The light beam from a gas laser passes through a
lens and falls on an artificial inhomogeneity in a cell containing the liquid
being studied. The deflected beam passes through a lens on the other side of
the cell and is focused on a coordinate-sensitive photocell that sends an
output signal to an oscilloscope. Calculations are given for determining
the necessary spatial resolution and sensitivity of the system. In experi-
ments on studying a temperature field in a liquid with a heated wire, the
measurable range of temperature gradients was found to be 1-10°C/mm, spatial
resolution was 60 lines/mm, and the minimum measurable angle of deflection was
10^{-5} rad. A comparison with temperature measurement by a non-optical tech-
nique showed a difference of no more than 3% over a range of 20-40°C. The
refractometer can be used for studying any parameters that result in an un-
steady field of the gradient of the index of refraction. Figures 2; refer-
ences 5 (Russian).

A PRECISION INSTRUMENT FOR MEASURING DEFORMATIONS OVER A RANGE OF 0.05-5000 μm

SAVINKOV, A. I.

[Abstract] This instrument is designed for deformation measurements in study-
ing the strength and elastic properties of crystalline and amorphous materials,
and also for tension and compression tests. It can also be used to measure
small displacements, for size checking and for quality control in automatic
and manual operation. Measured deformations and displacements over a range
of 0.05-5000 μm are displayed by a chart recorder or meter deflection (micro-
ammeter). The measurement error is no more than 0.5% of the full scale.
Input line deviations of ±10% cause no more than 0.1% instability of output
voltages for anode supply, and no more than 0.6% for heater supply. Measure-
ments of the instrument are 211 x 185 x 150 mm. The sensor is 100 mm long
and 35 mm in diameter. Figures 1.

AN INSTRUMENT FOR MEASURING THE INTENSITY OF RANDOM SIGNALS

ZHURAKOVSKIY, L. A., KOROTCHENKO, YU. I., UZENBAYEV, F. G. and CHICHILANOV,
V. V.

[Abstract] This instrument determines the number of surges of a random
quantity above a specified level in a selected time interval. The unit con-
tains a Schmidt trigger, a slave multivibrator, two integrating cells, two
electronic switches, a time relay and a scaling amplifier. The signal is
converted to square pulses of predetermined amplitude and duration. The
shaped signals are commutated to the integrator inputs so that one integrator
stores information while the stored information is being read out of the
other integrator during the same time period. The output is a voltage pro-
portional to the number of pulses exceeding the given level of selection.
The range of measured intensities is $10-10^4$ pulses per second, the relative
error of intensity measurement is ±10%, input signal amplitude is $10^{-4}-10$ V
and minimum time resolution is 10 μs. Power supply is 220 VAC 50 Hz, power
consumption is 60 VA. Measurements are 320 x 220 x 100 mm, mass is 3.6 kg.
Figure 1.

USSR

EXPERIMENTAL STUDY OF THE ACOUSTIC CHARACTERISTICS OF HYDROGEN DIFFUSION
FLARES

SVERDLOV, YE. D., Moscow

[Abstract] An experimental study was made of sound generated by open turbu-
lent diffusion flares of gaseous hydrogen, in a fuel jet leaving a nozzle 1-8
mm in diameter at velocities from 30 to 1200 m/s and with the Reynolds number
varying correspondingly. The acoustic characteristics were measured with
KFT (GDR) instruments including an MK-201 capacitive microphone and having a
160 dB sound-pressure range, while the flare geometry was recorded photo-
graphically with an AFA (USSR) aircraft camera. The acoustic spectra of a
hydrogen jet, much more uniform with than without burning of the fuel, reveal
three zones with different sound pressure and frequency characteristics (S.P.
denoting the sound pressure, f_0 denoting the fundamental sound frequency, N_{Ma}
denoting the Mach number, d denoting the nozzle diameter):

fully turbulent flare   S.P.$\sim$log $N_{Ma}^{3-3.5}$, S.P.$\sim$log $d^{2.2}$, $f_0 \sim d^{-0.5}$

laminar-turbulent flare S.P.$\sim$log N_{Ma}^7, $f_0 \sim N_{Ma}^3$

recessive flare   S.P.$\sim$log N_{Ma}^{7-8}, f_0 almost constant for d>2 mm and
slightly decreasing for $d \lesssim 2$ mm. The sound radiation pattern was found to
become more uniform, over a 120° angle, with burning of the fuel. The longi-
tudinal profiles of sound pressure measured in the near field and in the far
field reveal that most of the acoustic energy is generated farther from the
nozzle, where also the frequency rises, with the fuel burning. The author
thanks Yu. M. Annushkin for defining the problem and helping with the work.
Figures 5; references 7: 1 Russian, 6 Western.

SEMIEMPIRICAL METHOD OF STUDYING THE ACOUSTIC STABILITY OF GAS COMBUSTION

PODLEVSKIKH, N. A. and TARASYUK, V. A., Leningrad

[Abstract] The acoustic stability of combustion is analyzed by a compromise between a heuristic method with a simple mathematical model and an exact method requiring a more complete model. For this purpose empirical data are used on the distribution of pressure drops over the combustion zone, pressure being the most easily measured quantity. Here the general case of no premixing is considered, ignition beginning at section $x = 0$ and combustion ending at section $x = L$ in a cylindrical tube, with the transverse pressure gradients much smaller than the longitudinal ones. The equations of conservation are supplemented with the equation of state and the equation of total enthalpy for a steady adiabatic flow. Vibration processes where friction and heat transfer play a negligible role need to be considered, and power-law profiles of the gas-thermodynamic parameters are stipulated at the inlet. Furthermore, all equations are linearized with respect to small perturbations in the acoustic approximation. Results of this analysis, with appropriate empirical data on real flow conditions included in the "source" terms have yielded the stability region and limits for the case of a single-tube and for a typical 13-tube fuel mixer, depending on the length of the combustion zone, the length of the fuel concentration wave and the length of the pressure wave at a given excess air ratio. Noteworthy is the sharpy bending of the stability boundary, as the excess air ratio ($a \gtrless 1$) increases and the Strubal number ($N_{Sh} \gtrless 1$) increases with it. Figures 3; references 9: 5 Russian, 4 Western.

USSR

MAXIMONS AND THE HYPOTHESIS OF MAXIMON CLUSTERS

MARKOV, M. A., FROLOV, V. P., Institute of Physics imeni P. N. Lebedev, USSR
Academy of Sciences

[Abstract] Earlier works have postulated the existence of stable particles
with masses of about 10^{-5} g and analyzed the peculiarities of interaction of
such particles with matter. The purpose of this work is to turn the atten-
tion of the reader to the possibility of existence of a basically new class
of celestial bodies, long-lived gravitationally bound systems of maximons
(maximon clusters) and of some of the specific properties of such systems.
Such systems should have been formed as a result of gravitational instability
in the early stages of development of the universe if the maximon component
of matter was significant at the instant of the big bang. As such maximon
clusters continue to exist, they accrete surrounding matter, resulting in
their becoming "dirty." The movement of a "dirty" maximon cluster will lead
to the movement in space of the nucleonic matter which they have accumulated;
due to the extremely small interaction cross section of maximons, recording
of the movement of the nucleonic component of the maximon cluster would ap-
parently be easier than direct observation of the maximon component itself.
References 5: 3 Russian, 2 Western.

RESONANT SCATTERING OF FAST ELECTRONS IN A SINGLE CRYSTAL

KALASHNIKOV, N. P., and KOVALEV, G. B., Moscow Institute of Engineering and
Physics

[Abstract] It is demonstrated that resonances may be present in elastic
scattering for fast particles if the particle is scattered on an extended
attracting potential. Physically, the phenomenon consists in that there are
coupled and quasicoupled states in the cross section of an extended attract-
ing potential and, consequently, the transverse component of the incident
wave of the fast particle may experience resonant scattering on the states.
One necessary requirement for this is that the transverse movement of the
particle be "slow." This places a limitation on the incident angle of the
particle. This phenomenon can be observed in a crystal, when a fast parti-
cle enters the crystal at a small angle to a crystallographic axis. Figures
2; references 5: 2 Russian, 3 Western.

THE VARIATION OF g-FACTOR ANISOTROPY OF CHARGE CARRIERS IN BORON-DOPED PYRO-
CARBON WITH THE STRUCTURE OF QUASI-TWO-DIMENSIONAL GRAPHITE AS A FUNCTION OF
TEMPERATURE

KOTOSONOV, A. S.

[Abstract] A study is made of the temperature variation of the g-factor in
boron-doped pyrocarbon, which is considered a real-world approximation of
two-dimensional graphite, consisting of noninteracting monolayers. The speci-
mens were produced by precipitation of the products of pyrolysis of hydro-
carbons with boron impurity on a flat substrate at 2100°C. Doping with boron
produces the desired degree of degeneration of whole carriers and eliminates
heterogeneity in the distribution of carriers through the volume. The value
of the g-factor was determined by measurement of EPR signals between 4.2 and
1100 K. The equation which has been suggested earlier for calculation of
the charge carriers in two-dimensional graphite agrees well with the experi-
mental data. Figure 1; references 5 (Western).

INFLUENCE OF ION IMPLANTATION ON REFLECTION AND SURFACE POLARITONS OF
CRYSTALLINE QUARTZ

ZHIZHIN, G. N., YAKOVLEV, V. A., and SHIRMER, G., Institute of Spectroscopy,
USSR Academy of Sciences

[Abstract] A study is made of the spectrum of reflection and surface polari-
tons of crystalline a-quartz, the surface of which was treated with positive-
ly charged nitrogen ions with energies of 100 and 200 KeV and a density of
10^{15} cm^{-2}. The experimental spectra do not agree with those calculated by
the method of disrupted total internal reflection. Thus, ion implantation
of a-quartz results in significant changes in the reflection spectrum in the
area of the high frequency band of residual rays and in the spectra of sur-
face polaritons. Figures 2; references 7: 5 Russian, 2 Western.

THE MAGNETIC PROPERTIES OF VACANCIES IN A QUANTUM FERMI CRYSTAL WITH A PLANE
TRIANGULAR LATTICE

IORDANSKIY, S. V., Institute of Theoretical Physics, imeni L. D. Landau, USSR
Academy of Sciences

[Abstract] The magnetic properties of vacancies on a plane triangular lat-
tice are studied. For the triangular lattice, a basis configuration is de-
veloped in which the atoms with plus spin are located around the perimeter
of hexagons, atoms with minus spin are located in the center. Thus, the
ground state of He_3 atoms with a finite concentration of vacancies corres-
ponds to an unsaturated ferromagnetic with a magnetic moment of one third
of saturation. Figure 1; references 6: 2 Russian, 4 Western.

SHAPE OF FAST MOVING ELECTRON-HOLE DROPLETS

TIKHODEYEV, S. G., Institute of Physics imeni P. N. Lebedev, USSR Academy of Sciences

[Abstract] Electron-hole droplets deform the surrounding semiconductor. Their motion is opposed by the lattice. Here it is demonstrated that such a droplet should become increasingly oblate as it approaches the sound barrier. In the analysis, applied to sufficiently small droplets (radius $R_0 < 10^{-4}$ cm in germanium), the semiconductor is assumed to be isotropic and the effect of phonon wind on the droplet shape to be negligible. Calculations are based on respective Langrangians and include the deformation potential. It is shown how droplet energy depends on the ratio of the droplet semiaxes at various droplet velocities, and how the equilibrium ratio of the droplet semiaxes depends on the droplet velocity for droplets of various mean radii. The possibility of instability developing with a subsequent collapse of a droplet before it reaches the velocity of sound is not to be discounted. The author thanks L. V. Keldysh for the great help in formulating and solving the problem. Figures 2; references 4: 3 Russian, 1 Western.

RADIATION FROM CHANNELED ELECTRONS OF 4.7 GeV ENERGY IN DIAMOND

AGAN'YANTS, A. O., VARTANOV, YU. A. and VARTAPETYAN, G. A., Yerevan Institute of Physics, KUMAKHOV, M. A., TRIKALINOS, KH. and YARALOV, V. YA., Institute of Nuclear Physics, Moscow State University imeni M. V. Lomonosov

[Abstract] Recently the possibility of a new physical effect, namely spontaneous ∂-radiation from channeled relativistic particles had been suggested and evidence of it obtained in the case of electrons. Here quantitative experimental data are presented which rigorously confirm this effect with both axial and planar channeling of electrons. The experiment was performed with the inner electron beam of the Yerevan synchrotron, this beam having a divergence angle of approximately $2 \cdot 10^{-4}$ radian and carrying electrons of 4.7 GeV energy. The target was a correspondingly oriented single-crystal diamond. The corresponding ratio of the ∂-quanta yield to that with a non-oriented target was measured as a function of the quantum energy for each

mode of channeling. The increase of the ∂-quanta yield as a result of elec-
tron channeling and the peaking energy spectrum of the quantum yield agree
closely with theoretical predictions, except for a much lower than expected
but explainable peak ∂-quanta yield in the case of planar channeling, con-
sidering that the radiation occurs in a nondipole mode. Figures 2; refer-
ences 4: 3 Russian, 1 Western.

BAZYLEV, V. A. and ZHEVAGO, N. K., Institute of Atomic Energy imeni I. V.
Kurchatov

[Abstract] Under consideration is an ion with at least one electron in its
orbit and moving along a channeled trajectory in the direction of certain
crystallographic axes, these axes representing chains of uniformly spaced
identical atoms of the substance. The ion is assumed to be moving in the
field of only one such chain. One of the characteristic collision frequen-
cies (harmonics) is assumed to be close to the difference between the ground
state and excited state of electrons in the ion. It is shown that an elec-
tron will break away here, if the lifetime of its excited state is shorter
than or of the order of the ion transit time in the crystal. Since the theo-
ry of perturbation is not applicable in this case, calculations are based on
the Schroedinger equation in the 2-level approximation. Results are shown
for the extreme case of the indeterminacies within the two states differing
by much less than either the separation between both energy levels of the
resonance deficiency. Considering that the width of the ground state is not
at all ion velocities in a crystal much smaller than the width of the ex-
cited state, a vacancy is found to occur much more probably in the K-shell
than in the L-shell. This can be utilized for selective ionization of multi-
electron atoms. References 4: 2 Russian, 2 Western.

DIFFUSION FLAME IN A TURBULENT BOUNDARY LAYER BEHIND A SHOCK WAVE TRAVELING ALONG THE SURFACE OF A LIQUID FUEL

GENDUGOV, V. M., Moscow

[Abstract] A plane shock wave is considered which travels at a constant velocity through an originally quiescent gaseous oxidizer along the surface of a liquid fuel. The shape of the resulting flame behind and the rate of the chemical reaction taking place are determined from the solution to the simultaneous equations which describe a transient turbulent boundary layer of a chemically reacting mixture, with appropriate boundary conditions, in a system of coordinates tied to the shock wave. The reaction is assumed to occur only at the flame surface and the velocity profile across the boundary layer is approximated by $\frac{1}{7}$-power law. The results on this basis indicate that such a flame is a diffusion flame in the narrow sense, quasi-stationary and almost isobaric without premixing, to which the Shvab-Zel'dovich theory applies. References 7 (Russian).

CHARACTERISTICS OF A MONODISPERSED GAS-LIQUID MIXTURE WITH FLOW IN A VERTICAL PIPE

VALUKINA, N. V., KOZ'MENKO, B. K. and KASHINSKIY, O. N., Institute of Thermal Physics, Siberian Department, Academy of Sciences USSR, Novosibirsk

[Abstract] An investigation is made of the influence that the size of gas bubbles has on the characteristics of a two-phase flow in a vertical pipe. The working section of the experimental facility was a pipe 15 mm in diameter and 5 m high. A special bubbler was installed at the inlet to produce bubbles ranging in diameter from 0.1 to 1 mm with a size spread of no more than 15-20%. The hydrodynamic characteristics were measured by an electrochemical method. It was found that the structure of the flow and hence its characteristics are considerably dependent on the size of the gas bubbles at a fixed Reynolds number and volumetric discharge void fraction. Drag is generally

higher than in a one-phase flow. For bubbles 1 mm in diameter the drag falls
monotonically with increasing Reynolds number, approaching the value for a
one-phase flow. For bubbles of 0.1 and 0.5 mm diameter, there is an abrupt
increase in drag at Reynolds numbers larger than 700. This behavior is due
to the difference in gas distribution over the cross section of the pipe.
The gas phase in the flow distorts the velocity profile due to turbulization.
Figures 4; references 8: 4 Russian, 4 Western.

USSR

DEVELOPMENT OF TURBULENCE IN ROTATING FLUIDS

BELYAYEV, YU. N., MONAKHOV, A. A., SHCHERBAKOV, S. A., YAVORSKAYA, I. M.,
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ics, Moscow State University

[Abstract] A new approach to the problem of development of turbulence is
based on studies of the behavior of the trajectories of nonlinear dynamic
systems in phase space. It has been shown that these systems become sto-
chastic after three of four normal bifurcations, at which point an attract-
ing set, a strange attractor, on which all phase trajectories are unstable,
appears in the phase space. A study is made of the transition to turbulence
in a flow developing in a spherical layer of fluid upon rotation of an inner
sphere over a broad range of Reynolds numbers. It is found that the new
model describes the development of turbulence between the rotating spheres
much better than the old Landau model, in contrast to earlier observations
in a cylindrical layer. However, six bifurcations, not necessarily normal,
are observed before the system becomes stochastic, some frequencies disap-
pear with increasing Re, and there are discrete peaks against the background
of the continuous spectrum. Figures 3; references 9: 4 Russian, 5 Western.

CALCULATING THE FLOW OF A VISCOUS LAMINAR SUPERSONIC JET IN A WAKE

MYSHENKOV, V. I., Moscow

[Abstract] The author considers the two-dimensional axisymmetric problem of discharge of a viscous supersonic jet from a nozzle into an accompanying supersonic flow, assuming that the flow parameters are given in some initial cross section of the jet and the accompanying flow (for instance at the nozzle tip or at a certain distance away). A technique is proposed for calculating the flow of the jet from the initial section to the isobaric region and beyond that is based on solving a simplified system of Navier-Stokes equations. The equations are solved by a method of successive approximations. The numerical solution of the simplified equations is compared with the solution for an ideal fluid and with an approximation obtained by superimposing a known self-similar profile on the boundary of the jet in the mixing layer. Figures 6; references 13 (Russian).

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